dispersion phenomena occur due to the frequency-dependent velocity of propagation of the light in the optical fibers, that is to say a distortion of the input light pulse/input bit sequence in dependence on the path length. This chromatic dispersion of the optical fibers limits the maximum distance which can be spanned with the high-bit-rate transmission systems. Thus, for example, the usual single-mode optical fibers with a dispersion of 17 ps/nm*km at a wavelength of 1550 nm allow a distance of only 80-100 km (50-65 miles) in 10 Gbit/s systems which can be spanned without dispersion compensation. Any further doubling of the transmitted bandwidth reduces the maximum distance which can be spanned roughly by a factor of 4. The dispersion of the optical fiber must then be correspondingly compensated for in the case of longer transmission links.

Page 3, first full paragraph, lines 4 - 11, replace the entire paragraph with the following:

Among the electronic compensation methods, there are firstly the pre-chirp techniques. They are based on generating a negative frequency chirp of the laser diode, thus providing for appropriate precompensation. Furthermore, a reduction of the input bandwidth can be achieved by suitable modulation methods such as single-sideband modulation, duo-binary

modulation etc. and thus the maximum distance which can be

spanned can be increased, the bit rate remaining the same.

Page 4, third paragraph, lines 18 - 3 of page 5, replace the
entire paragraph with the following:

Another optical compensation technique is based on the

"chirped" Bragg gratings (implemented fiber-optically or

integrated optically). Although the "chirped" Bragg gratings

are somewhat more compact than the DCFs, they operate in

reflection mode and must thus be combined with a circulator.

Moreover, the dispersion bandwidth of a grating is limited and

each individual wavelength channel must be separately

compensated for. Furthermore, Bragg gratings which can be

adjusted over a wide range of dispersion cannot be easily

achieved because, in addition, the compensation bandwidth and

the reflection coefficient are dependent on the adjusted

dispersion.

Page 6, paragraph 5, lines 15 - 21, replace the entire
paragraph with the following:

A technical problem of the above-mentioned interferometric

structures consists in that, without cascading, they only

provide for very limited dispersion compensation while

simultaneously requiring a wide dispersion bandwidth. The

cascading necessary for this, in turn, unavoidably leads to a

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structure which is increasingly more difficult to implement and is more complex.

Page 6, last paragraph, lines 32 - 7 on page 7, replace the entire paragraph with the following:

Summary of the Invention:

The object of the present invention is to provide a dispersion compensator and a method for compensating for dispersion which overcome the above-noted deficiencies and disadvantages of the prior art devices and methods of this general kind, and wherein the system is capable of compensating for high dispersion values without cascading a number of filter stages and which, at the same time, has a broad bandwidth. Furthermore, the invention is intended to make it possible to generate adjustable dispersion values.

Page 8, second full paragraph, lines 11 - 18, replace the entire paragraph with the following:

In further summary, the inventor proposes here a structure which provides for high dispersion compensation at any dispersion bandwidth without cascading a number of filter stages. It is based on combining the two part-signals of an asymmetric Mach-Zehnder without forming interference in spite of an existing coherence. This is possible when the two

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signals are mutually orthogonally polarized when the signal is being recombined.

Page 12, third paragraph, lines 16 - 23, replace the entire paragraph with the following:

If there is no linearly polarized polarization state at the input of the compensator or there is a linearly polarized input state which does not correspond to the directions of the principal axis of the waveguides of the compensator and, at the same time, the waveguides of the compensator are anisotropic, the two signals with the different frequency bands are no longer orthogonally polarized when they are being combined.

Page 12, last paragraph, lines 25 - 6 on page 13, replace the entire paragraph with the following:

To recover the orthogonality in this case, it is also proposed in a special refinement of the invention that a fast controllable TE/TM phase shifter is arranged in at least one transmission link of the Mach-Zehnder, preferably behind the polarization converter. This makes it possible to ensure the orthogonality of the recombination signals when they are being combined by suitably driving the TE/TM phase shifter in the case of anisotropic waveguides.

<u>Page 16, last paragraph, lines 24 - 2 on page 17, replace the</u>
<u>entire paragraph with the following:</u>

Fig. 5 is a diagram showing dispersion compensation as in

Fig. 4 but expanded by a TE/TM phase shifter for compensating

for birefringent waveguides at any homogenous elliptical input

polarization state;

<u>Page 17, last paragraph, lines 15 - 2 on page 18, replace the</u>
<u>entire paragraph with the following:</u>

<u>Description of the Preferred Embodiments</u>:

Referring now to the figures of the drawing in detail and

first, particularly, to Fig. 1 thereof, there is seen a

diagrammatic illustration of a prior art assembly for

compensating for dispersion with the aid of an asymmetric

Mach-Zehnder interferometer having an input 15 and two outputs

(output 1 and output 2) at 16. The elementary functions

necessary for compensating for dispersion such as the spectral

division of the signal with the aid of a frequency division

multiplexer (FDM) 1, the spectrum-dependent time delay ΔL ($\Delta \tau$)

and the signal recombination in a multiplexer 3 are

implemented on a common substrate in the case of an integrated

implementation.

Page 18, second full paragraph, lines 15 - 21, replace the
entire paragraph with the following:

This configuration represents a filter stage. The phase

relationship of the waves interfering in the multiplexer 3

must not change too much as a function of the frequency in

order to be able to achieve the desired compensation

bandwidths without much intensity and time delay ripple.

However, this requirement limits the maximum achievable delay

time $\Delta\tau$, and thus the dispersion per filter stage.

Page 18, last paragraph, lines 23 - 6 on page 19, replace the
entire paragraph with the following:

As a consequence, it is only possible to achieve large

dispersion compensation over a large bandwidth by cascading a

number of asymmetric Mach-Zehnders (filter stages). Such an

implementation, normally used in the prior art, is shown in

Fig. 2. The individual asymmetric Mach-Zehnder interferometers

are here connected to one another by directional couplers 5

and, at the same time, fulfill the functions of frequency

division multiplex, frequency-dependent delay, and frequency

division demultiplex.

Page 19, first full paragraph, lines 8 - 19, replace the
entire paragraph with the following:

Due to the cascading, a progressive coherent superposition of

the wave components of the two interferometer arms is

generated. The greater the desired dispersion compensation with simultaneous large bandwidth, the more cascading stages are required. Thus, the implementation becomes increasingly more difficult, especially since the optical path length or, respectively, the phase of each interferometer or, respectively, of each filter stage, must be precisely monitored. This may be done by a thermo-optical phase shifter. Configurations with virtually arbitrarily adjustable compensation values, possibly by means of adjustable couplers, are conceivable but again increase the complexity.

Page 19, last paragraph, lines 21 - 5 on page 20, replace the entire paragraph with the following:

Fig. 3 shows a structure according to the invention of an optical dispersion compensator analogously to Fig. 1. Here, however, a polarization converter 6 is additionally inserted in the Mach-Zehnder arm 4.1 (interferometer arms). The aim is to achieve a signal recombination of two frequency bands without interference being formed due to their orthogonal polarization states. By appropriately dimensioning ΔL (difference in length of the Mach-Zehnder arms), time delays $\Delta\tau$ of the frequency band f_H can be achieved which have any magnitude, and this with a total bandwidth of the signal f_L + f_H which, at the same time, is of any magnitude.

<u>Page 20, first full paragraph, lines 7 - 24, replace the</u>
<u>entire paragraph with the following:</u>

The assembly firstly consists of the frequency demultiplexer

(FDM) 1 which divides the input spectrum into two frequency

bands f_L and f_H. The FDM 1 ideally has a rectangular frequency

response, i.e. having edges which drop off as steeply as

possible. In the asymmetric Mach-Zehnder interferometer

following, the two frequency bands f_L and f_H are subjected to a

different propagation delay. In the case of isotropic and, at

the same time, polarization-maintaining waveguides as is

basically possible, for example, with an integrated optical

form of implementation, the polarization input state as drawn

in Fig. 3 can have any elliptical shape. The polarization

states are specified by the configuration of the ellipses

shown. The polarization converter then converts the signal of

the Mach-Zehnder arm 4.1 from an arbitrarily elliptically

polarized state into an elliptically polarized signal which is

orthogonal thereto. This signal is then combined with the

time-delayed signal from the Mach-Zehnder arm 4.2 in the

multiplexer 3.

<u>Page 21, first paragraph, lines 1 - 6, replace the entire</u>
<u>paragraph with the following:</u>

The multiplexer 3 in which the two frequency bands are

combined and superimposed again may consist, in a simple

implementation, of a broadband 3dB coupler which entails an

additional power loss of about 3dB. In that case, an output of the multiplexer 3 can be used as monitor output. This can be used for monitoring the output power.

Page 21, second paragraph, lines 8 - 16, replace the entire paragraph with the following:

If, as shown in Fig. 3, the configuration consists of isotropic waveguides, an arbitrary elliptical polarization state of the input signal is permissible for its correct operation and the ellipse should be as identical as possible over the entire channel bandwidth. In the case of a linear input polarization state with identical axes, the multiplexer can be implemented by a TE/TM polarization combiner which makes it possible to combine the signals without 3dB power loss.

Page 21, last paragraph, lines 18 - 3 on page 22, replace the entire paragraph with the following:

The dispersion of the transmission link is only roughly approximated by the two-stage time delay in the case of weakly or non-dispersive waveguides which, however, can lead to a considerable improvement in the signal. Suitable dimensioning of the delay line ΔL can result in a two-stage time delay $\Delta \tau$ of any magnitude without cascading which means considerable simplification, especially in the case of large compensation values. Furthermore, the configuration manages without an

adjustable phase shifter. The configuration thus needs no further corrective control with permanently set FDM, polarization converter and multiplexer.

Page 22, first full paragraph, lines 5 - 8, replace the entire paragraph with the following:

If the dispersion of the transmission link is to be simulated ideally, it can be attempted to use in the Mach-Zehnder arms dispersive waveguides which have to be especially developed for the purpose.

Page 22, last paragraph, lines 20 - 3 on page 23, replace the entire paragraph with the following:

The configuration shown in Fig. 4 requires, analogously to Fig. 3, ideally either an identical homogenous input polarization state over the entire channel frequency bandwidth and, at the same time, isotropic waveguides, or a linear TE or TM input polarization state with arbitrarily anisotropic waveguides to function correctly. The configurations according to Figs. 3 and 4 are, therefore, particularly suitable for dispersion compensation preceding the transmission link, for instance directly following the emission laser with its defined linear polarization state.

<u>Page 23, first full paragraph, lines 5 - 17, replace the</u>
<u>entire paragraph with the following</u>:

If the configuration according to Fig. 4 can only be
implemented by means of anisotropic waveguides, it is
necessary to use an adjustable TE/TM phase shifter 9 in one of
the two Mach-Zehnder arms to obtain correct operation of the
dispersion compensator with an arbitrary homogenous elliptical
input polarization state. As shown in Fig. 5, this phase
shifter can be arranged, for example, following the
polarization converter 6. The phase shifter 9 ensures that the
two interferometer signals in the Mach-Zehnder arms 4.1 and
4.2 are orthogonal when they are combined. In this
configuration, the TE/TEM phase shifter 9 must compensate for
the accumulated difference in anisotropy of the two Mach-
Zehnder arms.

<u>Page 23, last paragraph, lines 19 - 24, replace the entire</u>
<u>paragraph with the following</u>:

For the general case of anisotropic waveguides of the
dispersion compensator, the input polarization state can also
be rotated by an additional preceding polarization controller
in such a manner that it is linearly polarized and, at the
same time, corresponds to one of the waveguide axes of the
dispersion compensator.

Page 24, second paragraph, lines 7 - 15, replace the entire paragraph with the following:

The polarization controller 17 of the configurations according to Figs. 6a, 6b controls the polarization state in such a manner that it corresponds to the principal axes of the waveguides of the subsequent dispersion compensator 18 (TE or TM polarization). The principal axes of the waveguides of the subsequent dispersion compensator 18 are thus allowed to have any anisotropy. At the same time, the polarization controllers 17 of Figs. 6a, 6b can be used for compensating for the polarization mode dispersion to a limited extent.

Page 24, last paragraph, lines 17 - 3 on page 25, replace the entire paragraph with the following:

As a further variant for an application of the configurations following the transmission link as shown in Figs. 3 and 4, it would be conceivable to use a preceding fast polarization scrambler 13 followed by a TE or TM polarizer 14. In this case, the waveguides 4.1, 4.2 of the dispersion compensator 18 are allowed to have any anisotropy since the input polarization state of the light wave is oriented in the direction of one of the principal axes (TE or TM polarization) by the preceding polarizer 14. The polarization scrambler 13 is used either at the link input or directly before the compensation element with the preceding polarizer. In any

case, the polarizer should be used immediately preceding the actual compensator element.

Page 26, lines 1 - 7, replace the entire paragraph with the following:

Overall, this invention provides a dispersion compensator and a method for compensating for dispersion which is able to compensate for high dispersion values without cascading a number of filter stages and, at the same time, has a great bandwidth. Furthermore, the invention makes it possible also to generate adjustable dispersion values.